warnings were issued at the proper time. Some inconvenience resulted, but the damage was insignificant.

Heavy rains at various times from the 9th to the 13th, inclusive, over Georgia and Alabama were followed by general floods in those States. The floods in Georgia, however, were not serious, although flood stages were general over the central and western portions of the State. Conditions were probably most pronounced along the Chattahoochee River where considerable damage of the usual character was done. At Columbus mills were obliged to close.

In the State of Alabama the rains were much heavier than in Georgia, and conditions much more serious. Warnings were first issued over the Alabama watershed on the 10th, with supplementary warnings on the 11th and 12th that the floods would be the highest of recent years, probably passing the 50-foot stage in the Alabama and extreme lower Coosa rivers.

Five lives were lost at Montgomery, and property along the river to the value of $450,000. It is estimated that the losses in live stock alone amounted to $200,000. The value of the property saved by the warnings about equaled the losses, although more of the latter may yet be reported, as several thousands of acres of oats were under water and may have been killed.

The warnings were of the greatest benefit to all classes, and those who were in a proper position to appreciate their value, have made frequent acknowledgment of the same.

The flood in the Black Warrior and lower Tombigbee rivers was as pronounced as that in the Alabama River, but the losses were trifling as a whole. The high waters were a distinct benefit to the lumber interests as they permitted the movement of logs to the value of $200,000. The value of the property saved through the Weather Bureau warnings was above $200,000, representing principally cattle and lumber in the lowlands.

The crest and flood stages in the Alabama, Black Warrior, and Tombigbee rivers were as follows:

Station.	Crest stage.	Flood stage.
	Feet.	*Feet.*
Montgomery, Ala.	51.7	35
Selma, Ala.	52.9	35
Tuscaloosa, Ala.	61.3	43
Demopolis, Ala.	61.5	35

The flood in the Pascagoula watershed of Mississippi was much more moderate, and the total losses did not exceed $15,000. The value of property saved by the warnings was also about $15,000.

Nothing of special interest occurred on other rivers.

ICE.

The Missouri River at Pierre, S. Dak., opened at 4 p. m. of the 6th, and after that date practically the entire river was open. The Red River of the North opened at Moorhead, Minn., on the 18th.

The Mississippi River remained frozen throughout the month at Fort Ripley, Minn. The ice moved out at St. Paul, Minn., on the 15th, at Red Wing, Minn., on the 23d, and at La Crosse, Wis., on the 31st. The river remained closed at Prarie du Chien, Wis., but at Dubuque, Iowa, it opened on the 21st. Farther down the river was open, although floating ice was observed at Le Claire, Iowa, as late as the 19th.

The rivers of Maine remain frozen, but the Connecticut opened at Bellows Falls, Vt., on the 11th and at Whiteriver Junction, Vt., on the 26th, remaining closed above the latter place.

The highest and lowest water, mean stage, and monthly range at 204 river stations are given in Table VI. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

SPECIAL ARTICLES, NOTES, AND EXTRACTS.

A CHRONOLOGICAL OUTLINE OF THE HISTORY OF METEOROLOGY IN THE UNITED STATES OF NORTH AMERICA.

This outline of the history of meteorology in the United States of North America has been prepared to meet a somewhat general demand for the information it contains. The contents represent the combined judgments of the members of the Washington staff of the United States Weather Bureau, and the Editor wishes to acknowledge the generous cooperation of all his colleagues.

While the choice of events to be regarded as important milestones in the history of the science of meteorology must be in part a matter of individual judgment, it is nevertheless possible to be uniformly correct in the facts stated and the dates given. This compilation aims at this ideal. It is hoped that at a later date this historical chronology of the science of meteorology may be supplemented by a chronological list of the more important meteorological phenomena of North America.—*C. A.*

1644–45. As far as known the first regular record of the weather on the American Continent was kept by the Rev. John Campanius at the Swedes' Fort, near Wilmington, Del.

1723. Prof. Isaac Greenwood, of Harvard College, recommended to the Royal Society of London a form for marine meteorological records.

1727–1738. First course of lectures on meteorology at Harvard College, by Prof. Isaac Greenwood.

1729–30. A regular weather record was kept at Boston, Mass., by Hon. Paul Dudley, Chief Justice of Massachusetts.

1730. Dr. John Lining began thermometer records at Charleston, S. C., using a Fahrenheit thermometer made in England and standardized there.

1738–1750. Regular meteorological observations were made at Charleston, S. C., by Dr. John Lining. These included Fahrenheit and other thermometers, the barometer, and the hygroscope.

1739. Benjamin Franklin (*b.* January 17, 1706, *d.* April 17, 1790) on his homeward voyage from England kept records of the weather and water temperatures, using an English Fahrenheit thermometer, and suggested a method of determining the approach of vessels to the American coast by the temperature of the water.

1739–1765. A regular course of lectures on meteorology delivered annually at Harvard College by Prof. John Winthrop.

1742–1778. Regular meteorological records were kept at Cambridge, Mass., by Prof. John Winthrop of Harvard College. He used a Hawksbee thermometer until 1763 and then a Fahrenheit.

1743. In September Benjamin Franklin, then Postmaster General, from the reports of numerous postmasters and from the fact that at Philadelphia, Pa., a storm prevented observations of an eclipse of the moon, while at Boston, Mass., the eclipse was over an hour before the storm began, deduced the progressive movement of a hurricane storm moving up from the West Indies. This is the first recorded instance in which the progressive movement of our storms as a whole was recognized.

1747. Publication at Philadelphia, Pa., of Lewis Evans's map, containing Franklin's rule "that all great storms begin

to the leeward," as did the storm observed in September, 1743.

1748. Meteorological records were kept by John Bartram at his botanic garden on the Schuylkill, near Philadelphia, Pa.

1749. November 9, Benjamin Franklin proposed to use pointed rods to draw down lightning.

1750. In the spring Franklin flew his electric kite with pointed wires, at Philadelphia, Pa.

1750–1759. Doctor Chalmers, at Charleston, S. C., continued the record begun by Doctor Lining.

1752–1765. Regular records of daily maximum and minimum temperatures by Prof. John Winthrop at Cambridge, Mass.

1752. Benjamin Franklin's letter to the Royal Society of London on lightning and electricity.

1753–1755. Meteorological records kept by Dr. Richard Brooke near Baltimore, Md.

1760–1762. Francis Fauquier, Lieutenant Governor of Virginia, kept a meteorological record at Williamsburg, Va.

1770. Dr. Hugh Williamson published "An attempt to account for the change of climate which had been observed."

1772–1777. Thomas Jefferson at Monticello, Va., and James Madison at Williamsburg, Va., maintained a series of contemporaneous observations and showed that the climatic peculiarities of those two places harmonize completely.

1780–1790. Prof. Samuel Williams at Harvard College continued the records formerly kept by Prof. John Winthrop; collected all available observations on the extreme temperatures experienced in eastern Massachusetts between 1752 and 1786; delivered excellent lectures on climatology; made a series of studies of the amount of evaporation.

1781. The Meteorological Society of the Palatinate at Mannheim began the publication of its "Ephemerides," which contained daily records from all accessible observers, including four from the United States, viz, Charleston, S. C., Philadelphia, Pa., New York, N. Y., and Cambridge, Mass.; the object being to search out or discover broad relations that might serve for long-range forecasts. These records were utilized by Brandes in 1825 to show that storms must be treated as entities moving over the surface of the earth.

1783. June 5, Benjamin Franklin describes the hot-air balloon sent up by Pilatre from Champs Elysees.

1783. Rittenhouse of Philadelphia, Pa., sends up hydrogen balloons simultaneously with European experiments.

1784. In May Benjamin Franklin while in Paris, after studying the influence of the great haze that spread over Europe from the eruption in 1703 of Kaptar Jokul in Iceland, announced his theory and his prediction or expectation of a cold winter.

1785. Benjamin Franklin appears to have again made a similar long-range prediction as to the coming winter in New England.

1789. Beginning of regular records of the freezing of the Hudson River at Albany, N. Y.

1790–1807. Prof. Samuel Webber kept the meteorological record at Harvard College.

1799–1806. Publication of a memoir by Doctor Webster "On the supposed change of the temperature of winter."

1800–1806. Prof. John Farrar at Cambridge, Mass., kept a record of meteorological observations with a "Daniell's hygrometer."

1806. Hon. Simeon DeWitt, of Albany, N. Y., read a memoir on "Climate in its Relation to Agriculture" before the American Agricultural Society in New York, N. Y.

1807–1817. Prof. John Farrar maintained a full weather record at Cambridge, Mass.

1807–1836. Prof. John Farrar annually delivers his "Lectures on the Atmosphere" as part of his duties as Hollis Professor at Harvard College.

1807. Hon. Simeon DeWitt read a paper before the Albany Institute describing his conical rain gage; in May, 1832, he described a similar and cheaper 9-inch conical gage, the use of which was wide spread at that time.

1812. On August 11 of this year Samuel Rodman began his meteorological record at New Bedford, Mass., which is still maintained by his descendants. It constitutes the longest continuous record in the United States.

1817. Josiah Meigs, Commissioner of the General Land Office, issued a circular dated April 29, in which he solicited meteorological records and phenological observations by the registrars of the respective land offices.

1819. The Surgeon General of the Army established a system of meteorological records at U. S. Army posts.

1819–1823. U. S. Army Topographical Engineers maintain meteorological records at the "Cantonment," 3 miles southeast of Council Bluffs, Iowa.

1820. James P. Espy (*b.* 1785, *d.* 1860) left his position in the Academy in Cumberland, Md., becoming Professor of Languages at the Franklin Institute in Philadelphia, Pa., and began his life-long work in meteorology.

1821. William C. Redfield discovered the rotation and progression of hurricanes.

1822. James P. Espy stated that he always observed the moisture of the atmosphere by means of the whirled wet-bulb or sling psychrometer. After having first made a number of comparative experiments with the dew-point apparatus, he found in general that the dew-point is as far below the temperature of the wet-bulb as that is below the dry-bulb.

1824. Beginning of the weather record at the Pennsylvania State Hospital, Philadelphia, Pa., which is continuous to the present date.

1825. The regents of the University of the State of New York established a system of meteorological records at the academies under their control.

1830. James P. Espy announced the cooling of ascending air by expansion. About this time Espy resigned from all his work as teacher and devoted himself to lecturing on meteorology.

1831. W. C. Redfield published the first of a long series of memoirs of importance on hurricanes as great revolving storms.

1835. July 2, first balloon ascension by John Wise at Philadelphia, Pa

1835–1840. Franklin Kite Club organized and conducted kite work in Philadelphia, Pa.

1836. Espy awarded the Magellanic Premium by the American Philosophical Society for his work in meteorology.

1836. Espy secured the appointment, by the American Philosophical Society and the Franklin Institute, of a joint committee for the study of storms.

1836. Nicollet prepared instructions for the use of the meteorological observers of the Surgeon General's Office.

1836. Elias Loomis compiled his memoir on "The Storm of 1836," the first of a long series of important memoirs. He also compiled instructions for taking meteorological observations for the use of the Surgeon General of the Army.

1837–1845. The Franklin Institute and the State of Pennsylvania cooperate in the establishment of meteorological stations in each county of the State.

1838. The first special appropriation in this country, of public money for the collection of weather information; the legislature of Pennsylvania made a grant of $4,000 to the Franklin Institute.

1838. Espy devised his first "nepheloscope" to show the formation of cloud or fog by sudden expansion of air, but found that the formation of cloud within the apparatus becomes more difficult with each successive expansion. He attributed this result to the washing out of the dust particles contained in the experimental air, thus in part anticipating the work of Aitken and Townsend in recent years.

1838. Establishment of the meteorological and magnetic observatory at Toronto, Canada.

1838–1842. U. S. Exploring Expedition to the Pacific Ocean under Commander Charles Wilkes, U. S. Navy. Its meteorological work is yet only partially published.

1838–1860. Lieut. M. F. Maury (*b.* 1806, *d.* 1873), Superintendent of the U. S. Naval Observatory, collected ships' logs; compiled and published sailing charts; wrote his work, "The Physical Geography of the Sea."

1838. James H. Coffin, while principal of the Academy at Ogdensburg, N. Y., began the publication of his monthly, "The Meteorological Reporter" which included the records for 1836–1838 made by his self-recording wind integrator which gave the number of hours that each direction of the wind prevailed during those years on the top of the mountain, Greylock, near Williamstown, Mass.

1840. August and September, Espy appeared before the British Association for the Advancement of Science at Glasgow, and the Academy of Sciences at Paris, to expound and defend his ideas as to the theory and cause of storms. A committee of the Paris Academy of Sciences reported favorably on Espy's theory of storms.

1840. Establishment by A. D. Bache (*b.* 1806, *d.* 1867), of the Meteorological and Magnetic Observatory of Girard College, Philadelphia Pa., where hourly observations of temperature and dew-point were made up to 1845.

1840–1850. Discussions between Bache, Henry, Hare, Johnson, Olmstead, and others, both in scientific magazines and newspapers, as to the character of our tornadic and other storms, and the nature of the forces involved therein.

1841. James P. Espy published his work on the "Law of Storms" maintaining the importance of the expansion of the rising air in the formation of thunderstorms, and explaining the special cloud formation known as "The Helm and Bar" in England, and the foehn-phenomena or the warmth of descending air. He also explained the diurnal variation in the wind force and direction; the dryness of descending air near cumulus clouds; the reason why an ascending current produced by a local conflagration might be expected to bring cloud and rain; the reason why some clouds are seen to be melting away and disappearing while others are growing larger and heavier.

1841. Loomis (*b.* 1811, *d.* 1889), published his map and study of the storm of December, 1836, in the Transactions of the American Philosophical Society at Philadelphia, Pa.

1842. Espy appointed "Meteorologist to the U. S. Government" by Congress and assigned to duty under the Surgeon General of the Army, and was so employed from August 26, 1842, to June 30, 1847.

1843. Prof. Dr. Robert Hare (*b.* 1781, *d.* 1858), opposes Espy and others and defends the idea that electricity is the important force in our storms.

1843. Charles Tracy published his memoir on the rotary movement of a storm. He concluded that this movement necessitates searching for a stable source of momentum and showed that the rotation of a storm is the effect of the earth's diurnal rotation, but did not arrive at the full measure of this influence.

1843. October, date of Espy's first meteorological report addressed to the Surgeon General of the Army.

1844. November, completion of the first line of Morse telegraph, between Washington and Baltimore. It was thrown open to the public April 1, 1845, and from this date onward, according to the testimony of old telegraphers, it was customary among the operators to advise each other of local weather by watching and predicting the movement of weather changes.

1847. Establishment by James Green of his workshop for the manufacture of the highest grade thermometers and barometers for the use of the Smithsonian Institution, the Surgeon General, the Army Engineers, and all other meteorological observers.

1847. December 8, Joseph Henry submitted his program of Organization and Work for the Smithsonian Institution, including first of all "A system of extended meteorological observations for solving the problem of American storms." The Smithsonian Institution continued after this date a prominent factor in the development of meteorology in the United States.

1847. Espy and Loomis addressed letters to Prof. Joseph Henry, as Secretary of the Smithsonian Institution, urging the importance of the establishment of meteorological stations and reports for the study of American storms.

1848. August 10, Espy appointed to meteorological work under the Secretary of the Navy and ordered to work in cooperation with the Secretary of the Smithsonian Institution where he prepared the first circulars of the Smithsonian Institution relative to securing meteorological observers.

1848. James Glaisher started daily weather reports for publication in the London Telegraph, and corresponded with the Smithsonian Institution as to similar work in America.

1848. J. Jones, of New York, N. Y., announced his intention of preparing weather maps and forecasts in New York City if properly supported financially, but the enterprise seems to have gone no further.

1849. November, date of Espy's second Meteorological Report (addressed to the Secretary of the Navy).

1850. Professor Guyot compiled the first edition of the Smithsonian Instructions for Meteorological Observers. (Published in 1852.)

1850. October, date of Espy's third Meteorological Report, (addressed to the Secretary of the Navy) with notes dated October, 1851.

[*To be continued.*]

WEATHER BUREAU KIOSKS.

By D. T. MARING, Instrument Division. Dated February 13, 1909.

In nearly all the large cities of the country at which regular, telegraphic-reporting stations of the Weather Bureau are established, the records from automatic instruments and the meteorological data recorded, as well as the daily observations and forecasts that are made, are always open for the benefit of the public, but, unfortunately, the modern development and construction of large and lofty buildings have necessitated the placing therein of the local offices and the exposure of the instruments on their high and comparatively inaccessible roofs. While such offices and instrumental records are, of course, still readily accessible to the public by means of rapidly-moving elevators, and information is easily procurable by universal telephone, yet, the great height of the instruments above the ground, which must be thus exposed for general forecast and climatological purposes, does not give the surface conditions in which the great mass of people move. For these reasons, therefore, there has been a growing demand for more accurate and reliable meteorological records nearer the ground, especially for temperatures, which the public has generally had to obtain as best it could from cheap and inferior thermometers improperly exposed in front of stores and shops.

With a view to meeting this demand in a practicable manner the Chief of the Weather Bureau directed that a suitable structure be designed for installation on street sidewalks, or within public parks, and, under the personal supervision of Prof. Chas. F. Marvin, in charge of the Instrument Division, the shelter shown in the accompanying illustration has been developed.

The name "Kiosk" was selected for this structure as being short and expressive, it being that employed in foreign countries for street shelters and bulletin boards used for a similar purpose. The designs of the foreign kiosks were, however, not found to be suitable to the demands in this country, and